

## CLAIMS

What is claimed is:

1. A method for executing an atomic transaction that involves a first plurality of operations that causes changes to a first set of data, the method comprising the steps of:  
performing a first operation of said first plurality of operations associated with the atomic transaction;  
during said step of performing the first operation, detecting a first error that prevents completion of the first plurality of operations;  
in response to detecting the first error, performing a second plurality of operations for resolving the first error;  
determining whether a resolution of the first error is obtained in response to performing the second plurality of operations; and  
if the resolution is obtained, then resuming execution of the first plurality of operations.
2. The method of Claim 1, wherein:  
the step of determining whether the resolution is obtained includes determining whether the resolution is obtained within a particular time period; and  
the method further comprises the step of, if the resolution is not obtained within said particular time period, then performing a third plurality of operations to remove all changes made by the atomic transaction to said first set of data.
3. The method of Claim 1, wherein:  
the method further comprises the step of determining whether the first error is a member of a predetermined set of errors for which corrective action is available for allowing the atomic transaction to be completed; and

5 said step of performing the second plurality of operations is initiated upon  
6 determining that the first error is a member of the predetermined set of errors.

1 4. The method of Claim 1, wherein:  
2 the method further comprises the step of detecting that the first error indicates a lack  
3 of sufficient resources to complete said atomic transaction; and  
4 the step of performing the second plurality of operations includes performing  
5 operations directed to obtaining additional resources.

1 5. The method of Claim 4, wherein the step of performing operations directed to  
2 obtaining additional resources includes inviting human intervention to supply the additional  
3 resources.

4 6. The method of Claim 4, wherein the additional resources include at least one of  
durable storage space, memory, processors, and communication bandwidth.

7. The method of Claim 4, wherein the additional resources include at least one of:  
storage space for a database associated with said first set of data; and  
storage space for storing undo information that indicates how to undo said changes to  
said first set of data.

1 8. The method of Claim 1, wherein:  
2 said step of performing the first operation further comprises the step of requesting a  
3 first resource by calling a first instance of a service; and  
4 said steps of detecting the first error, performing the second plurality of operations,  
5 and determining whether the resolution is obtained are performed by the first  
6 instance of the service.

1 9. The method of Claim 8, further comprising requesting a second resource during said  
2 requesting the first resource by calling a second instance of the service.

1 10. The method of Claim 9, further comprising the second instance performing the steps  
2 of:

3 detecting the first error; and

4 passing data indicating the first error to the first instance.

1 11. The method of claim 10, further comprising the second instance performing the step  
2 of aborting the request for the second resource in response to detecting the first error.

1 12. The method of claim 1, wherein the step of performing the second plurality of  
2 operations includes performing an operation that suspends execution of remaining operations  
3 of the first plurality of operations.

1 13. The method of claim 1, wherein the step of performing the second plurality of  
2 operations includes releasing all locks held on all resources as a result of the first operation.

1 14. A method for handling a call that requests a resource in a computer system, the  
2 method comprising the steps of:

3 receiving said call at a first instance of a service;

4 in response to said call, performing the steps of

5 adding to a data structure data indicating a first pending request for a first  
6 resource;

7 requesting the first resource;

8 determining whether a first error occurs during said requesting the first

9 resource; and

10 if the first error occurs, then

11 determining whether data indicating a second pending request for a second  
12 resource precedes the data indicating the first pending request in the  
13 data structure, and

14 if the data indicating the second pending request precedes the data indicating  
15 the first pending request, then responding to said call with data  
16 indicating the first error.

1 15. The method of Claim 14 wherein said step of requesting the first resource comprises  
2 the steps of:

3 determining whether providing the first resource depends upon obtaining a second  
4 resource; and  
5 if providing the first resource depends upon obtaining the second resource, then  
6 calling a second instance of the service to provide the second resource.

1 16. The method of Claim 15, further comprising, if providing the first resource does not  
2 depend upon obtaining the second resource, then performing the step of requesting the first  
3 resource from an operating system.

1 17. The method of Claim 14 further comprising, if the first error is not detected, then  
2 performing the step of responding to said call with data indicating a reference for the first  
3 resource.

1 18. The method of Claim 14, further comprising, if no data indicating the second pending  
2 request precedes the data indicating the first pending request, then performing the steps of:  
3 performing a plurality of operations for resolving the first error;  
4 determining whether a resolution of the first error is obtained in response to  
5 performing the plurality of operations; and

6 if the resolution is obtained, then responding to said call with data indicating a  
7 reference for the first resource.

1 19. The method of Claim 18, further comprising, if the resolution is not obtained, then  
2 performing the step of responding to said call with data indicating the first error.

1 20. The method of Claim 14, further comprising removing the data indicating the first  
2 pending request from the data structure before returning control to a routine that made the  
3 call to the first instance of the service.

1 21. The method of Claim 14, further comprising the step of de-allocating the data  
2 structure in response to determining that the data structure does not include at least one  
3 pending request.

1 22. A method for executing an atomic transaction that involves a first plurality of  
2 operations that causes changes to a first set of data, the method comprising the steps of:  
3 performing a first operation of said first plurality of operations associated with the  
4 atomic transaction;  
5 during said step of performing the first operation, detecting a first error that prevents  
6 completion of the first plurality of operations;  
7 determining whether the first error is a member of a predetermined set of errors for  
8 which corrective action is available for allowing the atomic transaction to be  
9 completed; and  
10 upon determining that the first error is a member of the predetermined set of errors,  
11 performing a second plurality of operations for resolving the first error,  
12 including  
13 releasing all locks held on all resources as a result of the first operation, and

performing an operation that suspends execution of remaining operations of  
the first plurality of operations;  
determining whether a resolution of the first error is obtained within a particular time  
period in response to performing the second plurality of operations;  
if the resolution is obtained, then resuming execution of the first plurality of  
operations; and  
if the resolution is not obtained within said particular time period, then performing a  
third plurality of operations to remove all changes made by the atomic  
transaction to said first set of data.

23. A computer-readable medium carrying instructions for executing an atomic  
transaction that involves a first plurality of operations that causes changes to a first set of  
data, the instructions for causing one or more processors to perform the steps of:  
performing a first operation of said first plurality of operations associated with the  
atomic transaction;  
during said step of performing the first operation, detecting a first error that prevents  
completion of the first plurality of operations;  
in response to detecting the first error, performing a second plurality of operations for  
resolving the first error;  
determining whether a resolution of the first error is obtained in response to  
performing the second plurality of operations; and  
if the resolution is obtained, then resuming execution of the first plurality of  
operations.

24. The computer-readable medium of Claim 23, wherein:  
the step of determining whether the resolution is obtained includes determining  
whether the resolution is obtained within a particular time period; and

the instructions further cause the one or more processors to perform the step of, if the resolution is not obtained within said particular time period, then performing a third plurality of operations to remove all changes made by the atomic transaction to said first set of data.

25. The computer-readable medium of Claim 23, wherein:

the instructions further cause the one or more processors to perform the step of determining whether the first error is a member of a predetermined set of errors for which corrective action is available for allowing the atomic transaction to be completed; and said step of performing the second plurality of operations is initiated upon determining that the first error is a member of the predetermined set of errors.

26. The computer-readable medium of Claim 23, wherein:

the instructions further cause the one or more processors to perform the step of detecting that the first error indicates a lack of sufficient resources to complete said atomic transaction; and the step of performing the second plurality of operations includes performing operations directed to obtaining additional resources.

27. The computer-readable medium of Claim 26, wherein the step of performing operations directed to obtaining additional resources includes inviting human intervention to supply the additional resources.

28. The computer-readable medium of Claim 26, wherein the additional resources include at least one of durable storage space, memory, processors, and communication bandwidth.

1 29. The computer-readable medium of Claim 26, wherein the additional resources include  
2 at least one of:  
3 storage space for a database associated with said first set of data; and  
4 storage space for storing undo information that indicates how to undo said changes to  
5 said first set of data.

1 30. The computer-readable medium of Claim 23, wherein:  
2 said step of performing the first operation further comprises the step of requesting a  
3 first resource by calling a first instance of a service; and  
4 said steps of detecting the first error, performing the second plurality of operations,  
5 and determining whether the resolution is obtained are performed by the first  
6 instance of the service.

1 31. The computer-readable medium of Claim 30, the instructions further cause the one or  
2 more processors to perform requesting a second resource during said requesting the first  
3 resource by calling a second instance of the service.

1 32. The computer-readable medium of Claim 31, the instructions further cause the second  
2 instance to cause the one or more processors to perform the steps of:  
3 detecting the first error; and  
4 passing data indicating the first error to the first instance.

1 33. The computer-readable medium of claim 32, the instructions further cause the second  
2 instance to cause the one or more processors to perform the steps of aborting the request for  
3 the second resource in response to detecting the first error.



1 34. The computer-readable medium of claim 23, wherein the step of performing the  
2 second plurality of operations includes performing an operation that suspends execution of  
3 remaining operations of the first plurality of operations.

1 35. The computer-readable medium of claim 23, wherein the step of performing the  
2 second plurality of operations includes releasing all locks held on all resources as a result of  
3 the first operation.

1 36. A computer-readable medium carrying instructions for handling a call that requests a  
2 resource in a computer system, the instructions causing one or more processors to perform  
3 the steps of:

4 receiving said call at a first instance of a service;

5 in response to said call, performing the steps of

6 adding to a data structure data indicating a first pending request for a first  
7 resource;

8 requesting the first resource;

9 determining whether a first error occurs during said requesting the first  
10 resource; and

11 if the first error occurs, then

12 determining whether data indicating a second pending request for a second  
13 resource precedes the data indicating the first pending request in the  
14 data structure, and

15 if the data indicating the second pending request precedes the data indicating  
16 the first pending request, then responding to said call with data  
17 indicating the first error.

1 37. The computer-readable medium of Claim 36, wherein said step of requesting the first  
2 resource comprises the steps of:  
3 determining whether providing the first resource depends upon obtaining a second  
4 resource; and  
5 if providing the first resource depends upon obtaining the second resource, then  
6 calling a second instance of the service to provide the second resource.

1 38. The computer-readable medium of Claim 37, the instructions further causing the one  
2 or more processors to perform the step of, if providing the first resource does not depend  
3 upon obtaining the second resource, then requesting the first resource from an operating  
4 system.

1 39. The computer-readable medium of Claim 36, the instructions further causing the one  
2 or more processors to perform the step of, if the first error is not detected, then responding to  
3 said call with data indicating a reference for the first resource.

1 40. The computer-readable medium of Claim 36, further comprising, if no data indicating  
2 the second pending request precedes the data indicating the first pending request, then  
3 performing the steps of:  
4 performing a plurality of operations for resolving the first error;  
5 determining whether a resolution of the first error is obtained in response to  
6 performing the plurality of operations; and  
7 if the resolution is obtained, then responding to said call with data indicating a  
8 reference for the first resource.

1 41. The computer-readable medium of Claim 40, the instructions further causing the one  
2 or more processors to perform the step of, if the resolution is not obtained, then responding to  
3 said call with data indicating the first error.

1 42. The computer-readable medium of Claim 36, the instructions further causing the one  
2 or more processors to perform the step of removing the data indicating the first pending  
3 request from the data structure before returning control to a routine that made the call to the  
4 first instance of the service.

1 43. The computer-readable medium of Claim 36, the instructions further causing the one  
2 or more processors to perform the step of de-allocating the data structure in response to  
3 determining that the data structure does not include at least one pending request.  
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